Klamath Network Featured Creature

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Mycorrhizae

FIELD NOTES:

General Description:
Mycorrhizae are a fungal symbiote with the roots of host vascular plants. They come in two main forms: Endomycorrhiza and Ectomycorrhiza. Endomycorrhiza are those species that penetrate the roots and the cell walls of the plant. Ectomycorrhiza differ in that they form a dense network of hyphae (a long filamentous extension) surrounding the roots.

Distribution and Occurrence
Mycorrhizae have been found to be present in 80% of all plant species studied, and are present in all parks and even in your backyard. They have also been detected in the fossil record going back 400 million years. It is probably no exaggeration to say, most wild plant could not survive without mycorrhizae.

The Symbiosis:
The symbiosis between plant and fungus is generally (but not always) mutualistic. The prime example is the exchange of carbon (from the photosynthetic plant) and minerals (from the mycorrhizae). The mycorrhizae greatly increase the surface area through their hyphae, making greater contact with the soil. Plants with mycorrhizae are hence much more efficient in absorbing necessary nutrients (nitrogen, phosphorous, other minerals) and water. In exchange, the mycorrhizae receive carbohydrates from the plant.

Plant/fungal benefits go beyond just this simple exchange. Research suggests that mycorrhizae help plants fight infection from pathogens and increase the tolerance of plants to heavy metal contamination. In instances where mycorrhizae help with heavy metals, this symbiosis has shown promise in bioremediation; where plants are used to remove toxins from contaminated soils.

Mycorrhizae growth

Photo by Kristin Haskins; http://www37.homepage.villanova.edu/jonathan.langley/projects.htm

Mycorrhizae
http://en.wikipedia.org/wiki/Mycorrhizae

Mycorrhizae hyphae
http://soil-environment.blogspot.com/2010/08/role-of-mycorrhiza-in-mineral-nutrition.html

Mycorrhizae and Climate Change:
Understanding mycorrhizae and their relationships to host plants have been a vital area of climate change research.

Increasing atmospheric CO_2 levels could potentially be mitigated by increased uptake of CO_2 by plant life. However, increased plant growth rates necessitate higher efficiency of nutrient uptake, especially nitrogen. Mycorrhizae are adept at exactly this, but it varies from plant species to plant species and among mycorrhizae species. General patterns necessary for predicting the role of plants and mycorrhizae in carbon sequestering are still not forthcoming.

Another area of study is in understanding how plants allocate carbohydrates to mycorrhizae. Currently, more carbon is sequestered by mycorrhizae than is emitted by human activity on an annual basis. Shifting or stimulating the mycorrhizae to store and receive even more carbon from the plants could help mitigate rising CO_2 levels.

Research has revealed that the relationship and feedback mechanisms of the host plant and the fungal symbiotes are complex, and feedbacks can be positive or negative. An example of a positive feedback is if increased CO_2 stimulates plant growth, the mycorrhizae further increase the uptake of CO_2. Negative feedback would be if the mycorrhizae slow the uptake of CO_2, even under increased atmospheric CO_2.

Further Information:
Klironomos lab: info on Long-term mycorrhizae research http://www.uoguelph.ca/~jnklab/index.html

Johnson lab: Northern Arizona soil ecology
http://www.nau.edu/~envsci/johnsonlab/index.htm

Langley lab: Villanova University “rhizosphere” studies
http://www37.homepage.villanova.edu/jonathan.langley/